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TO: Kathy Cupps, Southwest Regional Office

FROM: Joe Joy, EILS - Surface Water Investigations

SUBJECT: Results of the Seafood Processing Plant Survey Conducted in September 1988

ABSTRACT

Effluent samples were collected from four seafood processing plants in southwest Washington in September 1988. Evaluation of the analytical data against federal guidelines was limited by the lack of plant discharge volume records. Effluent appeared to be meeting existing source federal guidelines, but were also significant sources of biochemical oxygen demand (BOD), total suspended solids (TSS), oil and grease (O&G), and nutrients to receiving waters. Adverse impacts on poorly flushed receiving water areas were suspected, but could not be established by receiving water data collected during the survey. Several recommendations for improvement of permit data collection and records-keeping were made.

INTRODUCTION

There are over twenty-five firms processing fish, shrimp, crab or other seafood in Washington State. The Washington State Department of Ecology (Ecology) Northwest Regional Office (NWRO) and Southwest Regional Office (SWRO) staff are responsible for establishing and maintaining NPDES waste discharge permits for these facilities. Ecology currently follows USEPA waste treatment technology-based effluent limitations expressed in federal regulations: Chapter 40 CFR, Section 408. USEPA requires existing seafood processors to use best practicable technology (BPT), i.e. wastewaters are passed through a 40-mesh screen before they are discharged into receiving waters. Federal effluent limits are established for total suspended solids (TSS), oil and grease (O&G), and pH. These limits are production based: averages of 30-days continuous discharge, and one day maximums for specific product lines, e.g. northern shrimp, hand-butchered salmon, mechanized salmon processing, etc. (Table 1). New facilities must meet more restrictive technology-based TSS, oil and grease (O&G), and limits on five-day biochemical oxygen demand (BOD_5) as required under new source performance standards in Chapter 40 CFR, Section 408.

Ecology regional office staff have not regularly renewed or written seafood processing plant NPDES permits during the past few years. The industry has had a long history of regulatory difficulties. The regional staff also question whether the current guidelines establishing the level of treatment and monitoring adequately protect water quality in poorly or marginally flushed waterbodies. There are also problems applying the single product USEPA guidelines to mixed product effluents. However, the regional staff haven't had the processing plant effluent or receiving water data to evaluate if more stringent treatment and NPDES permit reporting requirements are appropriate.

In response to these concerns, the Surface Water Investigations Section (SWIS) of Ecology under-took a study to characterize seafood processing effluent and determine if it is causing water quality problems in various bodies of water. SWIS and SWRO staff[1] collected effluent samples from four seafood processing plants in southwest Washington during the mid-September, 1988 salmon gill-net fishing season. We also collected some limited receiving water data at two of these plants to discern whether effluent effects on dissolved oxygen, TSS, O&G, and nutrients were evident.

SURVEY DESCRIPTION AND METHODS

Four processing plants were selected for evaluation after consultation with the Ecology NWRO and SWRO staff. NWRO plants were not selected because: 1) some were discharging to municipal wastewater treatment plants (WWTP), 2) others were undergoing a change in design, and 3) one was too remote and sporadic in terms of production (D. Nunnallee, personal conversation). The four SWRO plants chosen represented a variety of receiving water environments, product lines, and production levels.

Figure 1 shows the location of the four plants studied, with a more detailed plan of each plant illustrated in Figures 2 - 5. Jessie's Ilwaco Fish Company and Chinook Fish Packing are located on Baker Bay, part of the Columbia River estuary; Willapa Seafoods is located at Bay Center in Willapa Bay, and East Point Seafoods is located at South Bend along the Willapa River. The two Baker Bay plants were in full operation, each running three product lines during our survey. East Point Seafood was only processing shrimp on a shorter than usual shift, and Willapa Seafoods was operating a full shift of hand-butchered salmon. Screens were in place at all plants. East Point and the two Baker Bay plants use a tangential screen to treat wastewater; Willapa Seafoods uses a double box screen at its outfall.

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Effluent from the Ilwaco wastewater treatment plant (WWTP) was also collected. Jessie's ties into the Ilwaco WWTP outfall line prior to discharge into Baker Bay. Mixed municipal and seafood processing effluent was sampled at the confluence of the two lines.

Effluent pH, temperature, and conductivity measurements were monitored with field probes on grab samples. Dissolved oxygen was measured using an azide modified Winkler titration. Grab samples were also collected for fecal coliform and O&G analyses. A single grab sample was collected of Willapa Seafoods wastewater prior to treatment by the screen. The design of the Willapa screen prevented collection of screened effluent.

Composite samples of treated (screened) effluent were collected at Jessie's, Chinook, and East Point in aliquots of 100 mL/15 min. over 24-hours. Compositors performed collection cycles whether effluent was present or absent. Sump pumps within the processing plant facilities determined the availability of effluent in the waste channels. Washdown water, discharged at the end of a production day, contributed to the composite sample volume. No estimate was made of its percentage of the total composite sample volume.

The composite sample taken from Chinook Packing was split and one was presented as a blind replicate. Production levels and water consumption volumes during the survey period were obtained from plant managers, except at Willapa Seafoods. Here, a stopwatch and bottle was used to estimate instantaneous discharge. Erratic pump cycles and the lack of specialized discharge monitoring equipment prevented us from obtaining accurate effluent discharge measurements to check against the managers' water consumption estimates at the other three plants.

Receiving water samples were scheduled to be collected in the vicinity of the Chinook and East Point plants during ebb tides. Salinity, dissolved oxygen (D.O.), temperature, and conductivity measurements were taken using field probes. Selected D.O. samples were analyzed using an azide modified Winkler titration. Effluent and receiving water samples for laboratory analysis were stored in the dark on ice and received by the Manchester Environmental Laboratory within 24-hours. Analyses listed in Table 2 were performed using methods detailed in Huntamer and Smith, 1988. Percent D.O. saturation levels were calculated from D.O., salinity and temperature data using the APHA, AWWA, WPCF (1985) formula.

EVALUATING EFFLUENT GUIDELINE COMPLIANCE

Standard methods for evaluating permit compliance of plants with mixed seafood effluent have not been developed. The USEPA effluent guidelines listed in Table 1 pertain to wastewater from single product lines in units of pollutant mass load per 1000 units product mass (Chapter 40 CFR, Section 408, 7-1-87 Edition). Limits on nutrients, bacteria, or other organic demand parameters have not been established.

To use the guidelines, daily production and water use volumes, and effluent concentrations must be known. Historically, these data have not been consistently monitored or reported for plants in this state. In the study, I had only estimates of water volumes used during production because of inadequate flow monitoring devices at the plants. I chose to evaluate the plant effluents in the following manner:

1. Maximum allowable TSS, O&G, and BOD_5 loads for each product (e.g. salmon, shrimp, bottomfish) were calculated by multiplying the USEPA guideline concentration (30-day average limits and one day maximum limits) by the plant production level.

2. Parameter loads were summed, divided by 8.35 and the reported flow (in million gallons/day) to get the estimated "maximum allowable" concentration.

3. The calculated maximum allowable mixed effluent concentrations were then compared to the results from samples collected at the plants.

Two sets of water use data were used for each plant. One set was based on the water consumption volumes given to us by the four plant managers. The other set was based on a comprehensive, national review of the industry reported by Jordan, Inc. (1979). Jordan's data are average water volumes used by similar, but single product plants. The second analysis (average water use in the industry) was performed because the water volumes given by the plant managers were very rough estimates. Plant water meters were not read during the survey, and the reported pump use probably contain a large degree of error. Usually the total volume based on reported pumping hours was far less than Jordan, Inc.'s (1979) findings. Also, some of the plants offer ice and water filling services to boats, and use water to washdown exterior decks and totes. The volume of water for those uses needs to be taken into account.

Water consumption during production is very important for evaluating production-based permit compliance. If less water is used, a higher concentration of a permitted pollutant is acceptable at a particular production rate. For both sets of calculations, effluent characteristics for each plant were compared to existing and new facility standards.

Considering all the water use estimates that were necessary, the evaluations of the survey data are very tenuous. Compliance of the plant effluents with federal limits cannot be established without accurate water consumption data. What follows is a brief description of the field observations, analytical and field sample results, and recommendations for better monitoring and regulation of seafood processing plants.

SITE VISIT OBSERVATIONS

Files at the SWRO contained little information on the physical layout of the processing plants. Complete schematic drawings of the water and wastewater systems for each plant should be provided by the owners for engineering review, site verification, and inclusion into the permit file.

Jessie's Ilwaco Fish Co. and Ilwaco WWTP

The Ilwaco WWTP and Jessie's are located in the port area on the south end of Ilwaco (Figure 2). The Ilwaco WWTP achieves secondary treatment of wastes generated in Ilwaco and the community of Seaview. Wastewater from Jessie's is not treated by the WWTP, but is tied into the WWTP effluent line at the WWTP site (Figure 2). The outfall is located outside the boat basin at about the three foot tide level. At tides lower than three feet, seafood processing wastewater and municipal effluent are discharged onto the tide flats. At mean lower low water (MLLW), the outfall is 0.7 miles away from the water's edge in Baker Bay.

At the time of the survey, shrimp shell lay piled in windrows near the outfall and several gulls were feeding on the piles. The sediments in the vicinity of the outfall area were black and appeared to be quite anaerobic.

Jessie's was running shrimp, salmon and bottomfish lines during the survey (Table 3). The plant hand-butchers salmon and mechanically processes bottomfish. Water consumption for the two days was calculated from a reported pump use of 90 gal./min. for 20 hours (D. Ross, phone conversation with K. Cupps, 9/16/88). The calculated volume was 31 - 43% of Jordan, Inc.'s (1979) industry averages and outside that range of nationally reported volumes. Plumbing appeared to be in good repair; no leaks were seen.

The tangential screen was not in use when we first arrived. Mixed shrimp, salmon and bottomfish wastes were being sent to a sump and then on through the waste tightline to the outfall. When this situation was pointed out to the manager, a bypass valve was switched and the wastes were routed from the sump over the screen. A new employee was to have engaged the screens earlier. Another employee stated that wastes other than shrimp were not usually screened. Kathy Cupps, SWRO Water Quality Inspector, sent a letter to the company afterwards stating that all wastes needed to be screened.

Chinook Packing

Chinook Packing is located in the Port of Chinook boat basin in Baker Bay (Figure 3). The processing plant discharges effluent to a sump, over a tangential screen, and through a submerged outfall into the boat basin at an undetermined depth. Chinook Packing was processing large quantities of shrimp, salmon (hand-butchered), and bottomfish (conventional processing) during the survey (Table 3). Water consumption for the two days was calculated based on a reported pump use of 90 gal./min. for 16 hours (T. Krager, phone conversation with K. Cupps, 9/16/88). The calculated volume was 20 - 31% of Jordan, Inc.'s (1979) industry averages, and lower than the range of nationally reported consumption rates.

During the survey, we observed that some of the lines under the plant were not connected to the treatment system. However, the water running from these was not colored or turbid as product line effluent would have been. Their source should be identified in the site plan.

Shrimp shell was clogging portions of the tangential screen during the survey. Solids and water deflected by the screen were draining into and around a collection dumpster. Spilled or leaking wastes were draining off the dumpster, onto the loading slab, and back into the sump. This posed a sanitation problem, but no threat to water quality.

East Point Seafoods

East Point Seafoods is located along the Willapa River at South Bend (Figure 4). Wastewater from the processing plant is directed over a tangential screen, into a concrete trough, and out a submerged outfall in the river. The Willapa River at the discharge site is tidally influenced and within the salt wedge during high tide.

The plant was running only a shrimp line on a half shift during the survey. No other lines were processing. Production volumes during the two day survey were lower than at Jessie's and Chinook (Table 3). Water consumption was given as 10 gal./lb. shrimp (L. Taylor, phone conversation with K. Cupps, 10/11/88). The calculated consumption was 39% greater than the industry average and range reported by Jordan, Inc. (1979) based on two northern shrimp processing plants (mean = 7.2 gal./lb., values = 5.8 and 8.6 gal/lb.).

The wastewater collection and screen area were well maintained. No leaks from the plumbing were observed under the plant. A complete schematic of the plumbing and wastewater system should be provided for the permit file.

More water used at a particular production volume means a lower acceptable effluent concentration on which to calculate the USEPA guidelines (lbs. pollutant/1000 lbs. product). In the case of East Point Seafoods, the acceptable effluent concentration became less restrictive using Jordan's (1979) data. If new source guidelines were used for compliance with Jordan's (1979) water volumes, most effluent concentrations would have exceeded the guidelines.

Fecal coliform levels in the effluent grab samples from Chinook and Willapa Seafoods were elevated (Table 4). The source of these bacteria in the wastestream is uncertain. Sanitary wastes should not be part of the processing wastes disposal system. Strasdine (1974) detected 50 to 5000 fecal coliform organisms/100 mL in untreated salmon canning wastes. *Citrobacter sp.* accounted for 70% of coliform species isolated in his samples. Strasdine also noted an increase in fecal coliforms in one set of his samples, and suggested that the reason may have been "... the shift in location of the salmon-catch from more distal marine areas to estuary and river caught fish. .." I did not collect samples at other times of the season to confirm changes due to catch location, nor did I speciate the coliform; but the coliform problem deserves additional attention.

Jessie's and Ilwaco WWTP data can be used to compare seafood processing effluent to municipal wastewater effluent (Table 4). The Ilwaco WWTP effluent discharge limit were not met for fecal coliform. The WWTP effluent TSS concentration, but not the TSS load exceeded Ilwaco's permit. These effluent conditions are not unusual for small municipal plants. Jessie's reported discharge volume was one-third of the WWTPs. However, Jessie's effluent had higher concentrations of some components. The differences between the two-day loads and average concentrations of some important wastewater components in the two effluents are compared in the following table:

	Ilwaco WWTP (mg/L)	Jessie's (mg/L)	Ratio, Jessie's:Ilwaco Concen.	Load
BOD_5	21	990	47	17
Total P	4.8	140	29	11
TSS	54	560	10	4
NO_2+NO_3	0.65	0.03	0.05	0.01
Ammonia	15	5.6	0.37	0.14

Jessie's contribution to loading of BOD_5, total phosphorus, and suspended solids to Baker Bay was up to seventeen times greater than the WWTP's. The WWTP's contribution of nitrogen, coliform, and chlorine loading was greater than Jessie's. The comparison suggests that the addition of seafood processing plant effluent has a significant impact on waste loading to the bay during the processing season.

Willapa Seafoods

Willapa Seafoods is located at the Bay Center boat basin on Willapa Bay (Figure 5). The plant was operating a hand-butchered salmon line at full capacity. However, the volume of salmon processed was less than processed at the Baker Bay plants (Table 3). The wastewater volume was small, consisting of washwater, blood, and a small amount of solid material. Waste and washwaters fell through floor grates and passed through piping to a double box screen tied to the floating dock. The screen and piping had recently been installed. There appeared to be some minor problems with the screen because it hit the pipe at high tide and the effluent partially missing the screen at low tide. Screened effluent samples could not be collected since the screens were sitting on a float, but only a few solids appeared to be present in the effluent. It was also unclear how solids would be cleaned from the screens and where they were disposed.

EFFLUENT RESULTS

Field and laboratory results for all the samples taken at the plants are listed in Table 4. BOD_5, TOC, TSS, and ammonia concentrations in the seafood plants' effluents were generally quite similar (coefficient of variation 0.2 to 0.6). Fecal coliform, total phosphorus, and O&G effluent concentrations showed the widest variability between plants (coefficient of variation 0.8 to 1.8). East Point O&G concentration appeared to be unusually low and may be a sampling or analysis error. The Manchester Laboratory reported that an interfering substance may have compromised three O&G and four nitrate+nitrite samples (Table 4).

The heterogenous characteristics of seafood processing wastes are demonstrated by the Chinook composite sample and duplicate results, especially the poor agreement between the TSS concentrations. The effluent characteristics of the East Point process and washdown grab samples are also quite different. The quality and quantity of washdown water is not addressed in the USEPA guidelines.

As stated earlier, USEPA guidelines for mixed-product seafood effluent are absent, so I calculated effluent limits based sum of the maximum allowable load for each product line (see above). Most plants' screened effluent met all of the existing plant TSS and O&G effluent limits when the reported water volumes were used (Table 5). One O&G grab from East Point was greater than the 30-day average calculated limit. Chinook effluent limits were less stringent than Jessie's because Chinook reported a lower water consumption volume.

Some effluent O&G and TSS samples exceeded the existing plant 30-day average guidelines when reported water volumes were substituted with Jordan's (1979) national averages (Table 5). This was because Chinook Packing and Jessie's Ilwaco Fish Company reported water consumption for lower than Jordan's (1979) national averages.

When compliance monitoring schedules are arranged, it will be important to sample the effluent frequently and consider sample collection timing to gain statistical confidence needed to evaluate permit compliance. Flow proportioned composite sampling would be best to establish TSS (and BOD_5, ammonia, and nutrients as well) compliance, but four or more grab samples taken at equal intervals and composited over an 8 or 10-hour processing day may be adequate. O&G grabs should be taken during the processing period, and one during washdown. These should not be composited. To establish both maximum and 30-day criteria compliance, weekly sampling should be performed during the primary processing season(s) when 30 consecutive days of processing would probably occur. A less intensive sampling schedule may be appropriate during the off-season. This should be stated in the permit.

Seafood Plant Effluent Characteristics Summary

Seafood processing plant effluent contains much higher concentrations of BOD_5, TSS, and total phosphorus than secondary effluent from municipal treatment plants. However, the seafood processing plant effluents sampled appeared to meet most of the USEPA effluent limits for existing plants. Fewer new source limits would have been met. Compliance with federal limits was evaluated using maximum allowable concentrations based on reported production and water consumption data. Water consumption or wastewater discharge rates were not performed accurately at any of the plants. Therefore, the evaluation results are tenuous. Compared to plants in a comprehensive national review of the industry (Jordan, Inc., 1979), the two Baker Bay plants reported water consumption far lower than average, while East Point used more water. For the Baker Bay plants, substituting an industry average water consumption for the reported consumption meant more stringent treatment guidelines. A detailed plumbing diagram for each plant would have been helpful to identify wastewater sources and lines within the plants. Some plant managers needed to make sure screens were better maintained, and were being used while processing was in progress.

RECEIVING WATER QUALITY

The receiving water areas monitored were chosen to compare two different estuarine conditions. Chinook Packing discharges to a boat basin isolated from circulatory movements of the Columbia River estuary so that tidal flushing of the boat basin is the primary means of dispersing the effluent. The Chinook entrance channel and boat basin are dredged annually by the U.S. Army Corps of Engineers (COE) (Blanchard, 1978). The dredging may remove much of the accumulated organic materials in the sediments. In contrast, East Point Seafoods discharges directly into a tidally effected portion of the Willapa River and effluent is not as isolated from tidal and river currents. Both survey sites experience varying degrees of fresh and marine water mixing or stratification in the vicinity of their outfalls.

The Chinook boat basin was visited twice and the Willapa River area once. Sample collection was very limited and several problems with monitoring equipment were experienced. General observations based on the data collected follow.

Chinook Boat Basin

Vertical profiles and samples were collected during the first half of ebb tides during both visits to the boat basin (Figure 3). The tide stage was higher during the second survey than the first. Weather conditions during the first sampling period were warm and calm; during the second, weather was cool, windy and rainy. Stations are shown in Figure 3, and field data for both days are listed in Table 6. In all cases salinities were such that Class A marine water standards were applicable for D.O. and fecal coliform (WAC 173-201-035(2)).

Water in the boat basin was much more stratified during the first survey than the second in terms of salinity and temperature (Table 6). Water with higher salinities was also deeper and colder. The volume of the boat basin also contained a higher content of water with >20 ppt. salinity the first survey than the second. These salinity and temperature profiles matched general historical low flow patterns in the Columbia River channel (Jay, 1978), and salinities reflect 0.5 to 2 volumes of seawater mixed in one volume fresh water.

During the first survey, the D.O. at all depths appeared to be most depressed at the innermost site. The D.O. at the one meter depth nearest the processing plant outfall was also depressed relative to the other profiling sites. Generally, all D.O. concentrations in water below two meters, where salinities were >20 ppt. were severely depleted both inside and outside of the boat basin.

Ammonia and total phosphorus were higher within the basin than toward the mouth (Table 6). The ratio of phosphorus to ammonia could show some promise as an indicator of seafood processing plant effluent in the receiving water. The ratio in the effluent is approximately 25:1 in contrast to naturally lower ratios in both the freshwater and marine/estuarine environment. The concentrations of ammonia and total phosphorus appeared elevated in the Chinook boat basin, but no background concentrations were available for comparison and mass balance calculations.

The second survey showed improved D.O. conditions at all sites. All D.O. concentrations were within the Class A marine water criterion of 6 mg/L, and were greater than 78% of D.O. saturation (Table 6). Surface D.O. concentrations and percent saturations were higher than those taken at depth. The most depressed D.O. levels were located at the two meter depth within 100 feet of the outfall. Surface D.O. saturations were generally higher at the mouth of the basin than inside.

Complex mixing and reaction processes of ocean and river water in the Columbia River estuary and on the Baker Bay tide flats complicate interpretation of the Chinook receiving water data. The Class A marine water quality criterion is 6.0 mg/L except when lower D.O. is a result of natural conditions, then man-caused degradation is not to exceed 0.2 mg/L [WAC 173-201-045(2)(ii)(B)]. Two-thirds of the D.O. concentrations in the first survey were lower than 6.0 mg/L. Preliminary estimates of the boat basin intertidal volume indicate that BOD_5 loading to the basin may impair D.O. unless tidal exchange is very efficient. However, the level of impairment directly attributed to the seafood processing effluent remains unresolved.

According to Jay (1978), the Columbia River estuary experiences seasonal low D.O. in September. The reasons for the D.O. depletion are: increased amounts of organic matter, increased oxidation rates of organic matter, and reduced solubility of D.O. in saltier and warmer waters. These factors make water quality in the estuary especially vulnerable to additional waste sources during the low flow period (Jay, 1978).

Background D.O. and other water quality conditions could not be identified using this survey data, so the relative impacts of the Chinook Packing effluent on the boat basin were not clarified. Therefore, a more complete and detailed study of the Chinook Packing receiving water over a tidal cycle should be required for the permit renewal process. Impacts of effluent on water and sediment quality during seafood processing season and during the annual dredging of the boat basin should be assessed. Stations should be placed to determine background conditions, flushing efficiency, and solids retention in the basin. Chinook Packing effluent should be sampled for BOD_5, TSS, O&G, ammonia and total phosphorus during the receiving water survey.

Willapa River

Vertical profiles and samples were collected during the last part of flood tide, slack and beginning of ebb tide (Figure 4). Weather during the sampling period was cool with light winds. Stations are shown in Figure 4, and field data for both days are listed in Table 6. In all cases, salinities were such that Class A marine water standards were applicable for D.O. and fecal coliform (WAC 173-201-035(2)). East Point was still discharging under reduced production conditions at the time of the survey.

Currents were still moving upstream when monitoring began off the East Point Seafoods plant. Salinities and temperatures were fairly uniform at surface to 6.5 m. depth: 25.5 - 26.6 ppt. and 14.1 - 14.7°C. (Table 6). The higher temperatures coincided with higher salinities. The salinities are typical for a mixture of three volumes of seawater (35 ppt.) in one volume of freshwater.

All D.O. concentrations were within the Class A marine water criterion of 6 mg/L, and were greater than 78% of D.O. saturation (Table 6). Better D.O. conditions tended to be at five meters or deeper. D.O. saturation levels less than 80% were detected at the surface and one meter depth of Stations 1 and 2, farthest east of the outfall area (Figure 4).

The phosphorus to ammonia ratio in the East Point Seafoods effluent was approximately 5.5:1, far lower than Chinook Packing and Jessie's Ilwaco Fish Company effluent ratios. At East Point, the ratio would probably be less helpful for tracking effluent in the receiving water than at Chinook or Ilwaco. Ammonia and total phosphorus sample results did not indicate any conclusive effluent impacts on water column quality. They were within the normal range of Willapa River nutrient values compared to Ecology monthly monitoring data at two stations in the area.

The receiving water data were not adequate to evaluate the impact of East Point Seafood effluent on the Willapa River. A more intensive sampling survey would be needed during a period of full plant production and over a longer period of time. A comparison of water and sediment quality data from shallow areas in the vicinity of the plant and along the left bank of the river away from the plant may be helpful.

Receiving Water Surveys Summary

The surveys were not very successful in determining the impacts of seafood effluent on receiving water quality. Control station data were not adequate to calculate mass balances and loading of important effluent components. Background water quality variability in the receiving waters was high during the time of peak effluent discharge. There are concerns whether the Chinook boat basin can adequately maintain water quality standards during periods of low basin flushing efficiency. BOD_5 loading from Chinook Packing effluent may be contributing to critically low D.O. conditions in the boat basin.

CONCLUSIONS AND RECOMMENDATIONS

The seafood processing plant survey conducted in southwest Washington fell short of its goals of determining federal effluent limit compliance by the four plants monitored, and the impacts seafood processing effluent has on poorly flushed receiving waters. Key data on processing plant water consumption and receiving water background concentrations were missing. The data collected at the plants and in the receiving waters provided the following information:

- Discharge Monitoring Reports for seafood processing plants visited during the survey were inadequate. Accurate data on daily water consumption and production need to be consistently reported to establish proper permit limits and to evaluate NPDES permit compliance.

- Seafood processing effluent contains far greater concentrations of total phosphorus, BOD_5, and TSS than municipal WWTP effluent. The seafood processing plants contribute a very significant load of these materials to the receiving water during the summer critical period.

- Effluent from Chinook Packing may be impairing water quality in the boat basin during a portion of the late summer critical period. Annual maintenance dredging of the boat basin and entrance channel may be mitigating extended or increased impairment between sediment and the water column.

- The combined outfall for Jessie's and the Ilwaco WWTP is unacceptable given the current guidelines. Any future plant modifications should reconsider outfall placement and design.

Based on the findings of this survey, the following recommendations are made:

- A complete schematic of the water and wastewater systems should be requested and kept on file after review and site verification.

- Seafood processing plants need to accurately report daily water consumption and daily production volumes. Water use for product lines should be metered independently of other water use needs at the plant, e.g. lavatories, ice-making, deck/loading area washdown, and water service to boats. Weekly, semi-monthly, or monthly monitoring of effluent pH, TSS, and O&G needs to be performed and reported. Although not required for existing plants, effluent BOD_5 should be monitored when the discharge is located in poorly flushed waters. To establish 30-day criteria compliance, weekly sampling should be performed during the primary processing season(s) when 30 <u>consecutive</u> days of processing are expected to occur.

- Flow proportioned composite sampling would be best to establish TSS (and BOD_5, ammonia, and nutrients as well) compliance, but four or more grab samples taken at equal intervals and composited over an 8 or 10-hour production day may be adequate. At least two fecal coliform and O&G grabs should also be taken while product effluent is discharged, and one taken during washdown.

- Washdown water is very different from processing effluent and should be considered in monitoring schedules, and should not be over-represented.

- The source of elevated fecal coliform counts in some seafood processing effluents needs to be investigated, especially where a historical problem has existed in the effluent or receiving water. Periodic monitoring of fecal coliform should be performed at all plants as a preventative measure, e.g. quarterly grab sample, or when the primary location of product catch changes.

- The background conditions in the receiving waters of the seafood plants in this survey need more detailed documentation. Background water quality conditions during the critical period change quickly in the estuarine areas over the tide cycle and over a month's time.

- Receiving water monitoring, especially at the Chinook boat basin, should be performed over an entire tidal cycle as part of the discharge permit application and renewal process. Flushing efficiencies and effluent dispersion should be calculated.

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Table 1. USEPA seafood processing effluent limit guidelines: CFR 40, Chapter 1, appropriate for products processed during the September 1988 survey of plants in southwestern Washington. Units are lbs./1000 lbs. of product.

PRODUCT	PARAMETER	EXISTING PLANTS		NEW PLANTS	
		30-day average	One day maximum	30-day average	One day maximum
Northern Shrimp	TSS	54	160	15	38
	Oil & Grease	42	126	5.7	14
	BOD_5	--	---	62	155
Hand-butchered Salmon (West Coast)	TSS	1.6	2.6	0.42	0.70
	Oil & Grease	0.19	0.31	0.026	0.045
	BOD_5	---	---	1.7	2.7
Non-Alaskan Coventional Bottom Fish	TSS	2.0	3.6	0.73	1.5
	Oil & Grease	0.55	1.0	0.042	0.077
	BOD_5	---	---	0.71	1.2
Non-Alaskan Mechanized Bottom Fish	TSS	12	22	2.9	5.3
	Oil & Grease	3.9	9.9	0.47	1.2
	BOD_5	---	---	7.5	13

Table 2. Samples collected and field measurements taken during the seafood processing plant survey in southwestern Washington in September 1988.

Location	Sample Type	Parameters: Field/Laboratory
Jessie's Ilwaco Fish Co.	Effluent Composite (9/13 - 9/14/88)	Temperature, conductivity, pH / BOD_5, TOC, NH_3-N, NO_2+NO_3-N, Total Phosphorus, TSS
	Grabs: 9/13- 1233	Temperature, conductivity, salinity, pH, D.O./ Fecal Coli., NH_3-N, NO_2+NO_3-N, Total Phos., O&G
	9/13- 1515	Temp., conductivity, salinity, pH / O&G, f.c.
Ilwaco Municipal WWTP	Effluent Composite (9/13 - 9/14/88)	Temperature, conductivity, pH / BOD_5, TOC, NH_3-N, NO_2+NO_3-N, Total Phosphorus, TSS
	Grab: 9/13- 1245	Temperature, conductivity, salinity, pH, D.O., Total residual chlorine / Fecal Coli., NH_3-N, NO_2+NO_3-N,Total Phos., O&G
Combined Jessie's & Ilwaco WWTP	Effluent Composite (9/13 - 9/14/88)	Same as Ilwaco WWTP/Same as Ilwaco WWTP
	Grabs: 9/13- 1208	Same as Ilwaco WWTP plus instantaneous discharge
	9/13- 1500	Temp., conductivity, salinity, pH / O&G, f.c.
Chinook Packing	Effluent Composite (9/13 - 9/14/88)	Same as Jessie's / Same as Jessie's
	Grabs: 9/13- 1123	Temperature, conductivity, salinity, pH, D.O./ Fecal coli., NH_3-N, NO_2+NO_3-N, Total Phos., O&G
	9/13- 1435	Temp., conductivity, salinity, pH / O&G, f.c.
Chinook boat basin	Grabs: 9/14	Temperature, D.O., conductivity, salinity / NH_3-N, TSS, NO_2+NO_3-N, Total Phosphorus, fecal coliform, O&G.
Chinook boat basin	Grabs: 9/26	Temperature, D.O., conductivity, salinity /
East Point Seafoods	Effluent Composite (9/26 - 9/27/88)	Same as Jessie's / Same as Jessie's
	Grabs: 9/27- 0925	Temperature, conductivity, pH,/ Fecal Coli., NH_3-N, NO_2+NO_3-N, Total Phos., O&G
	9/27- 1125	Temp., conductivity, pH / O&G, f.c.
	9/27- 1727	Temp., conductivity, pH, Total residual chlorine / BOD_5, TSS, NH_3-N, NO_2+NO_3-N, Total Phosphorus
Willapa Seafoods	Grab: 9/27- 1025	Temperature, pH, conductivity / BOD_5, TOC, O&G, Fecal Coliform, NH_3-N, NO_2+NO_3-N, total phosphorus, TSS
Willapa River near East Point Seafoods	Grabs: 9/27	Temperature, D.O., conductivity, salinity / NH_3-N, TSS, NO_2+NO_3-N, Total Phosphorus, Fecal Coliform, O&G.

Table 3. Reported seafood processing production levels during the September 1988 survey.

Plant	Product	First Day Lbs. Processed	Second Day Lbs. Processed	Total Production
Jessie's Ilwaco Fish Company	Northern shrimp	13,000	15,500	28,500
	Hand-butchered Salmon	38,000	77,000	115,000
	Mechanized bottom fish	31,500		31,500
Chinook Packing	Northern shrimp	20,000	20,000	40,000
	Hand-butchered Salmon	140,000	80,000	220,000
	Conventional bottom fish	50,000		50,000
East Point Seafoods	Northern shrimp	13,000	16,000	29,000
Willapa Seafoods	Hand-butchered Salmon	37,530*		37,530*

* Willapa Seafoods production reported for the period Sept. 22 - 30.

Table 4. Results from samples and measurements taken during a seafood processing plant survey in southwest Washington, September 1988. All values are mg/L, unless otherwise indicated.

Effluent Source	Location	Date	Sample Type/Location	Product Processed	Dischg MGD	Temp. deg.C	pH s.u.	Sp.Cond. umhos/cm	Diss. O2	T.Res Chlor	F. coli. (#/100 mL)	BOD_5	TOC	NO_3-N	NO_3+ NO_2	Total P	O&G	T.Sus Solids
Jessie's Ilwaco Fish Co.	Ilwaco	09/13/88	composite/screened	Shrimp-28,500 lbs.	0.05							990	500	5.6	0.03	140		560
		09/13/88	grab/screened	Salmon-115,000 lbs.		18.4	8.21	6100	7.6		170			3.6	0.01	92	632	660
		09/13/88	grab/screened	Bot.fish-31,500 lbs.		19.0	8.19	4800			92						704	
Ilwaco WWTP	Ilwaco	09/13/88	grab/final effluent	——	0.16	23.1	7.05	570	5.4	0.40		21	13	15.0	0.65	4.6		44
		09/13/88	grab/final effluent		0.14						4200	21		13.0	0.55	4.7	<1	64
Combined Jessie's & Ilwaco WWTP	Ilwaco	09/13/88	composite/manhole	——	0.21							350	160	15.0	0.33	36		240
		09/13/88	grab/outfall		0.64	19.5	7.75	4500			85			6.2	0.05	65	4066*	470
		09/13/88	grab/manhole			20.5	7.57	3220			160						1329*	
Chinook Packing	Chinook	09/13/88	composite/screened	Shrimp-40,000 lbs.	0.04							1400	690	3.7	0.09	100		800
		09/13/88	grab/screened	Salmon-220,000 lbs.		18.5	8.06	14700	6.8		610			1.1	0.13	30	99	660
		09/13/88	grab/screened	Bot.fish-50,000 lbs.		17.5	7.13	12500			2200						1710*	
		09/13/88	duplicate of composite									1300	730	4.5	0.08	120		1140
East Point Seafoods	So. Bend	09/26/88	composite/screened	Shrimp- 29,000 lbs.	0.15		8.17	450				1500	760	3.3	0.21**	18		560
		09/27/88	grab/screen-process			13.5	7.94	490			150	2000	1000	3.0	0.28**	22	56	820
		09/27/88	grab/screen-washdwn			13.4	7.89	125			300	6		0.2	0.25**	0.3	12	9
		09/27/88	grab/screen-process			11.2	8.32	610										
Willapa Seafoods	Bay Center	09/27/88	grab/prescreen***	Salmon- approx. 10,000 lbs.	0.0005	14.2	7.62	580			8300 K	1400	919	2.8	0.21**	34	24	160

K = Estimated value due to non-ideal plate count
* = NaSO4 crystals present, value may be high.
** = Analytical interference, value may be low.
*** = Treated (screened) sample could not be collected - see text.

Table 5. Calculated "maximum allowable" mixed and single product effluent concentrations based on USEPA production based guidelines, plant total production levels, and using reported and industry average water consumption volumes. Units in mg/L.

Plant	Guideline	Parameter	CRITERIA: Reported Water Use: One-day maximum	Reported Water Use: 30-day average	Indust. Avg. Water Use: One-day maximum	Indust. Avg. Water Use: 30-day average	Survey Sample Data
Jessie's Ilwaco Fish Company	Existing Plants	TSS	6052	2290	2047	775	560, 680
		Oil & Grease	4293	1462	1431	488	632, 704
	New Plants	TSS	1450	618	569	242	560, 680
		Oil & Grease	482	197	189	77	632, 704
		BOD_5	5600	2397	2200	942	990
Chinook Packing	Existing Plants	TSS	9972	3642	1708	624	800,660,1140
		Oil & Grease	7192	2439	1237	419	99, 1710*
	New Plants	TSS	2438	1016	499	208	800,660,1140
		Oil & Grease	800	329	163	67	99, 1710*
		BOD_5	9556	4029	1957	824	1400, 1300
East Point Seafoods	Existing Plants	TSS	1916	647	2737	924	560, 820, 9
		Oil & Grease	1509	503	2156	719	58, 12
	New Plants	TSS	455	180	711	281	560, 820, 9
		Oil & Grease	168	68	262	107	58, 12
		BOD_5	1856	742	2900	1160	1500, 2000, 8
Willapa Seafoods	Existing Plants	TSS	1007	620	519	319	160**
		Oil & Grease	120	74	62	38	24**
	New Plants	TSS	271	162	205	123	160**
		Oil & Grease	17	10	13	8	24**
		BOD_5	1047	659	789	497	1400**

* Value may be high due to interfering substance.
** Values are raw wastewater, before screening.

Table 6. Receiving water quality data collected during the September 1988 survey of seafood processors in southwestern Washington. All values mg/L unless otherwise indicated.

Receiving Waterbody	Date of Survey	Site*	Depth (m)	Temp. (deg. C)	Salinity (ppt)	Cond. (umhos/cm)	Probe (%)	Diss.02 D.O.sat.	Winkler Diss.O2	TSS**	NH_3-N**	NO_2-NO_3-N**	Total** Phos.	Fec.Coli. (org/100mL)	TOC**
Chinook Boat Basin	09/14/88	1	0	21.0	12.8	19200	7.0	64.6							
	09/14/88		1	17.2	20.5	27800	4.6	54.1							
	09/14/88		2	15.0	25.0	31600	2.7	31.2		40	0.26	0.27	0.13	11	1
	09/14/88		3	14.5	26.5		4.2	48.5	4.7						
	09/14/88	2	0	18.5	11.8	17800	7.6	87.0	8.1						
	09/14/88		1	15.0	19.5	24000	5.1	57.0							
	09/14/88		2	13.8	25.0	29800	5.1	57.5							
	09/14/88	3	0	19.0	13.8	18200	8.5	99.5							
	09/14/88		1	17.6	16.4	22000	6.5	75.4		35	0.22	0.25	0.10	28	20
	09/14/88		2	13.8	25.0	30000	4.6	51.9							
	09/14/88		3	13.5	27.2	32000	4.3	48.9	4.5						
	09/14/88	4	0	20.0	12.5	18500	7.4	87.6	8.6						
	09/14/88		1	18.5	19.8	27500	5.0	60.0							
	09/14/88		2	16.8	23.8	31200	4.8	57.1		42	0.12	0.26	0.10	-	-
	09/14/88		3	15.8	26.5	32800	4.4	52.2							
	09/14/88	5	0	23.5	15.0	17500	7.8	100.1							
	09/14/88		1	18.0	21.5	29000	5.0	60.1							
	09/14/88		2	18.0	23.2	31200	4.6	55.8							
	09/14/88		3	20.2	23.2	13330	3.6	45.6	5.1						
	09/26/88	6	0	14.6	11.0	18900	9.1	95.7	9.2						
	09/26/88		1	14.4	12.4	20800	9.0	95.1							
	09/26/88		2	14.3	13.4	22600	8.8	93.4							
	09/26/88	7	0	14.7	10.4	18100	9.2	96.6	9.4						
	09/26/88		1	14.5	12.2	21000	8.9	94.1							
	09/26/88		2	14.2	13.7	22400	8.7	92.3							
	09/26/88		3	13.6	16.8	27600	7.8	83.3							
	09/26/88		4	13.7	16.3	27000	7.8	83.2							
	09/26/88		5	13.8	16.3	26900	7.8	83.0							
	09/26/88	8	0	14.7	10.4	18100	8.9	93.5	9.1						
	09/26/88		1	14.2	13.5	22700	8.4	89.0							
	09/26/88		2	13.8	15.6	26000	7.8	83.0							
	09/26/88	9	0	14.5	10.4	18000	8.9	93.1							
	09/26/88		1	14.1	13.9	23400	8.0	84.8							
	09/26/88	10	0	14.5	12.1	21000	8.8	93.0							
	09/26/88		1	14.0	14.4	24000	8.3	88.0							
	09/26/88		2	13.4	20.8	32900	7.2	78.5							
	09/26/88		3	12.6	25.2	39700	8.1	89.2	8.0						
	09/26/88		4	12.3	26.3	41100	8.2	90.3							
	09/26/88	11	0	14.4	12.1	20600	8.9	93.9	9.0						
	09/26/88		1	13.8	15.2	25300	8.1	86.0							
	09/26/88		2	13.4	20.0	32600	8.0	86.7							
	09/26/88		3	12.4	25.7	40200	8.1	89.1							

Table 6. (continued)

Receiving Waterbody	Date of Survey	Site*	Depth (m)	Temp. (deg. C)	Salinity (ppt)	Cond. (umhos/cm)	Probe (%)	Diss.02 D.O.sat.	Winkler Diss.O2	TSS**	NH_3-N**	NO_2-NO_3-N**	Total** Phos.	Fec.Coli. (org/100mL)	TOC**
Willapa River at South Bend	09/27/88	1	0	14.8	25.6	40300	6.80	78.6	6.95						
	09/27/88		1	14.5	25.7	40400	6.80	78.2							
	09/27/88		2	14.4	26.0	40700	6.96	80.0							
	09/27/88		3	14.4	26.0	40700	6.93	79.6							
	09/27/88		4	14.4	26.0	40700	6.93	79.6	7.40						
	09/27/88	2	0	14.8	25.5	40000	6.77	78.1		23	0.08	0.05	0.06		
	09/27/88		1	14.5	25.9	40600	6.83	78.5							
	09/27/88		2	14.4	26.1	40900	6.96	80.2							
	09/27/88		2.8	14.3	26.2	40900	7.03	80.7		60	0.08	0.05	0.11		
	09/27/88	3	0	14.4	26.2	41000	7.03	80.9		29	0.07	0.05	0.06		
	09/27/88		1	14.3	26.3	41100	7.07	81.2							
	09/27/88		2	14.3	26.3	41100	7.11	81.7							
	09/27/88		5	14.3	26.5	41300	7.13	81.9	7.45	35	0.07	0.05	0.06		
	09/27/88	4	0	14.3	26.2	41000	7.08	81.3	7.25	23	0.09	0.05	0.06		
	09/27/88		1	14.3	26.3	41200	7.10	81.5							
	09/27/88		2	14.2	26.4	41200	7.15	82.1							
	09/27/88		5	14.2	26.4	41300	7.15	82.0							
	09/27/88		6.5	14.2	26.4	41300	7.15	82.0	7.45	39	0.07	0.04	0.07		
	09/27/88	5	0	14.4	26.2	40900	6.94	79.8	7.30	25	0.07	0.05	0.06		
	09/27/88		1	14.3	26.3	41100	7.01	80.5							
	09/27/88		2	14.2	26.4	41100	7.07	81.2							
	09/27/88		5	14.1	26.5	41500	7.13	81.7							
	09/27/88		6.5	14.1	26.6	41400	7.14	81.9		46	0.06	0.04	0.08		
	09/27/88	6	0	14.5	26.0	40700	6.97	80.3		23	0.08	0.05	0.06	29	28
	09/27/88		1	14.4	26.1	40900	6.96	80.1							
	09/27/88		2	14.4	26.2	40900	6.98	80.3							
	09/27/88		5	14.1	26.5	41300	7.15	81.9							
	09/27/88		6.5	14.1	26.5	41300	7.15	81.9		46	0.07	0.05	0.06		
	09/27/88	7	0	14.6	25.8	40500	6.99	80.6	7.20	23	0.07	0.06	0.10		
	09/27/88		1	14.6	26.0	40700	6.96	80.3							
	09/27/88		2	14.4	26.0	40700	7.03	80.7							
	09/27/88		5	14.2	26.5	41300	7.17	82.2							
	09/27/88		6.5	14.2	26.5	41300	7.13	81.8	7.40	46	0.07	0.05	0.09		
	09/27/88	8	0	14.9	25.6	40100	6.98	80.6	7.15	26	0.09	0.05	0.07		

* Sites are located on Figures 3 (Chinook Packing) and Figure 4 (East Point).
** Samples were collected as vertical composites of surface, mid-depth, and bottom waters.

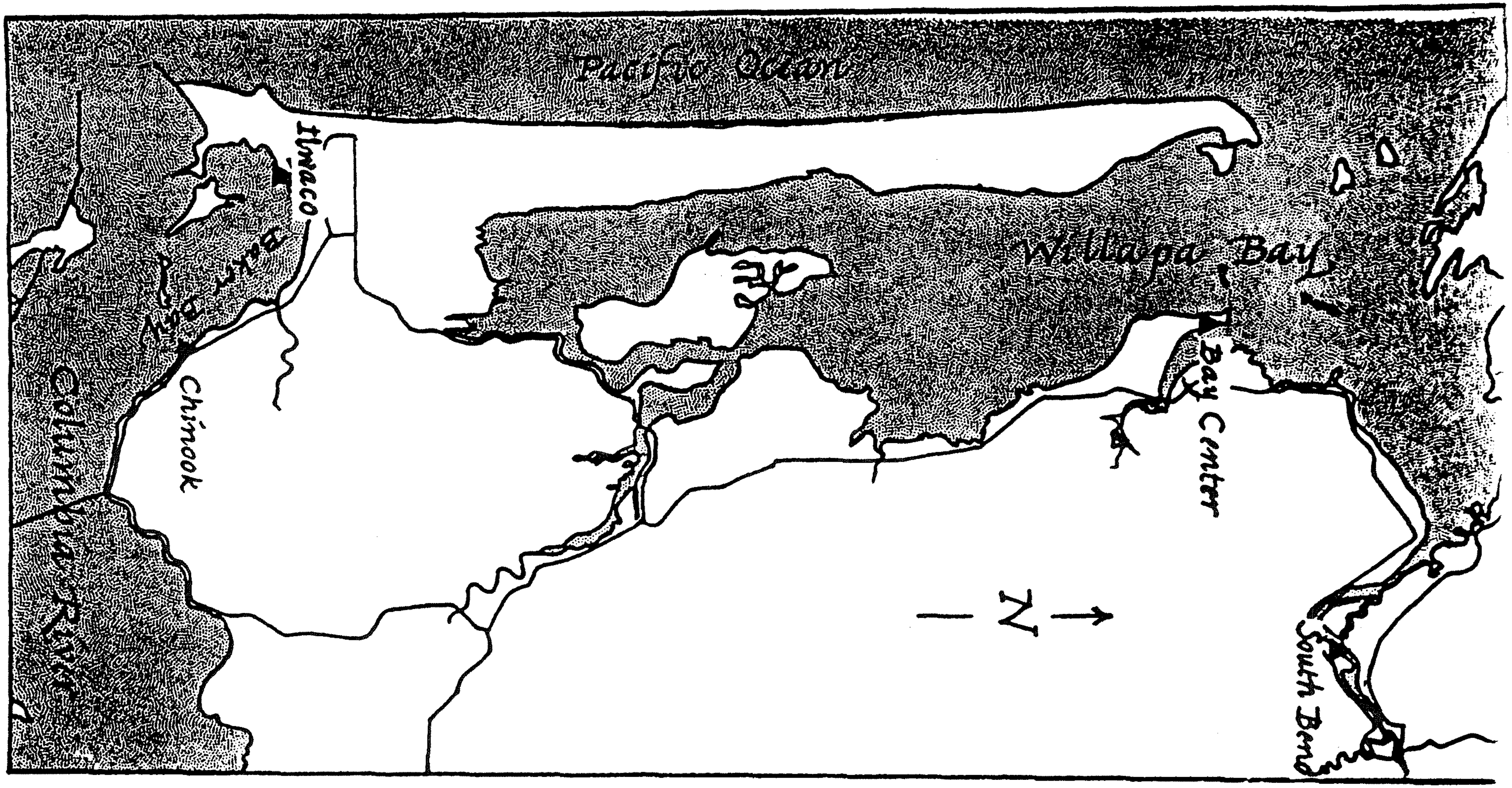

Figure 1. Location of (▲) four seafood processing plants in southwest Washington monitored during the September 1988 survey.

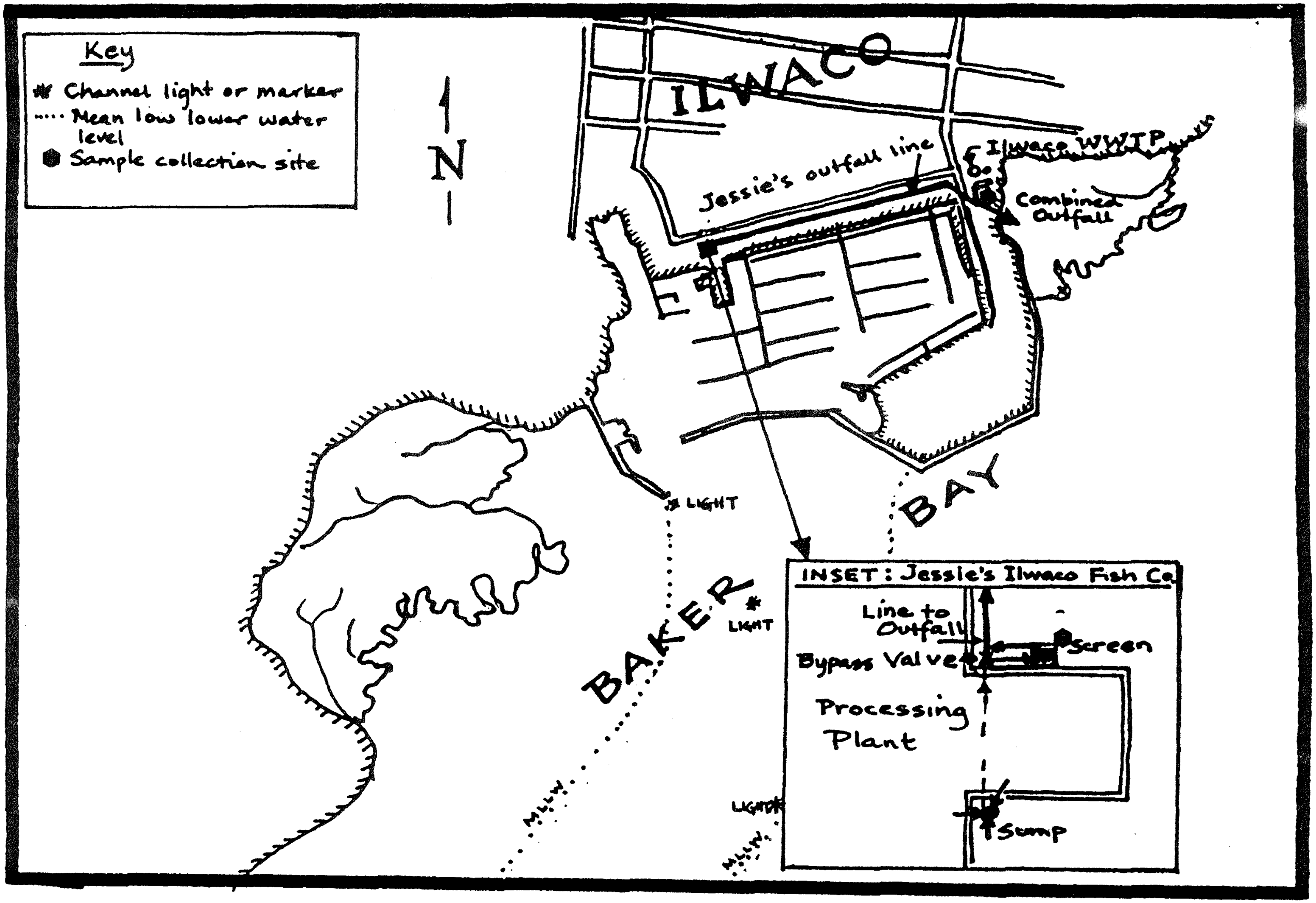

Figure 2. Jessie's Ilwaco Fish Company site and sampling locations used during the September 1988 survey.

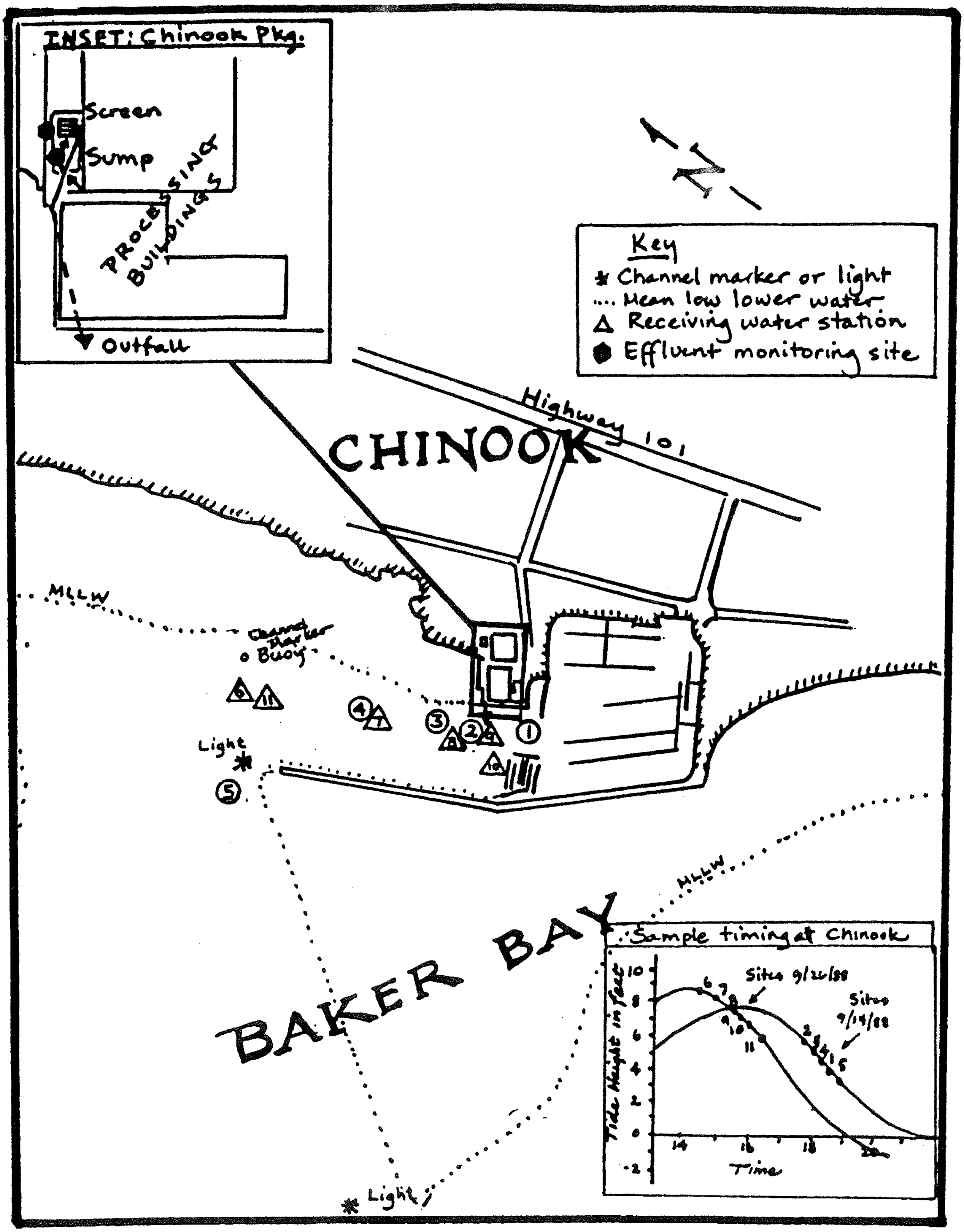

Figure 3. Chinook packing site and location of samples taken during the September 1988 survey.

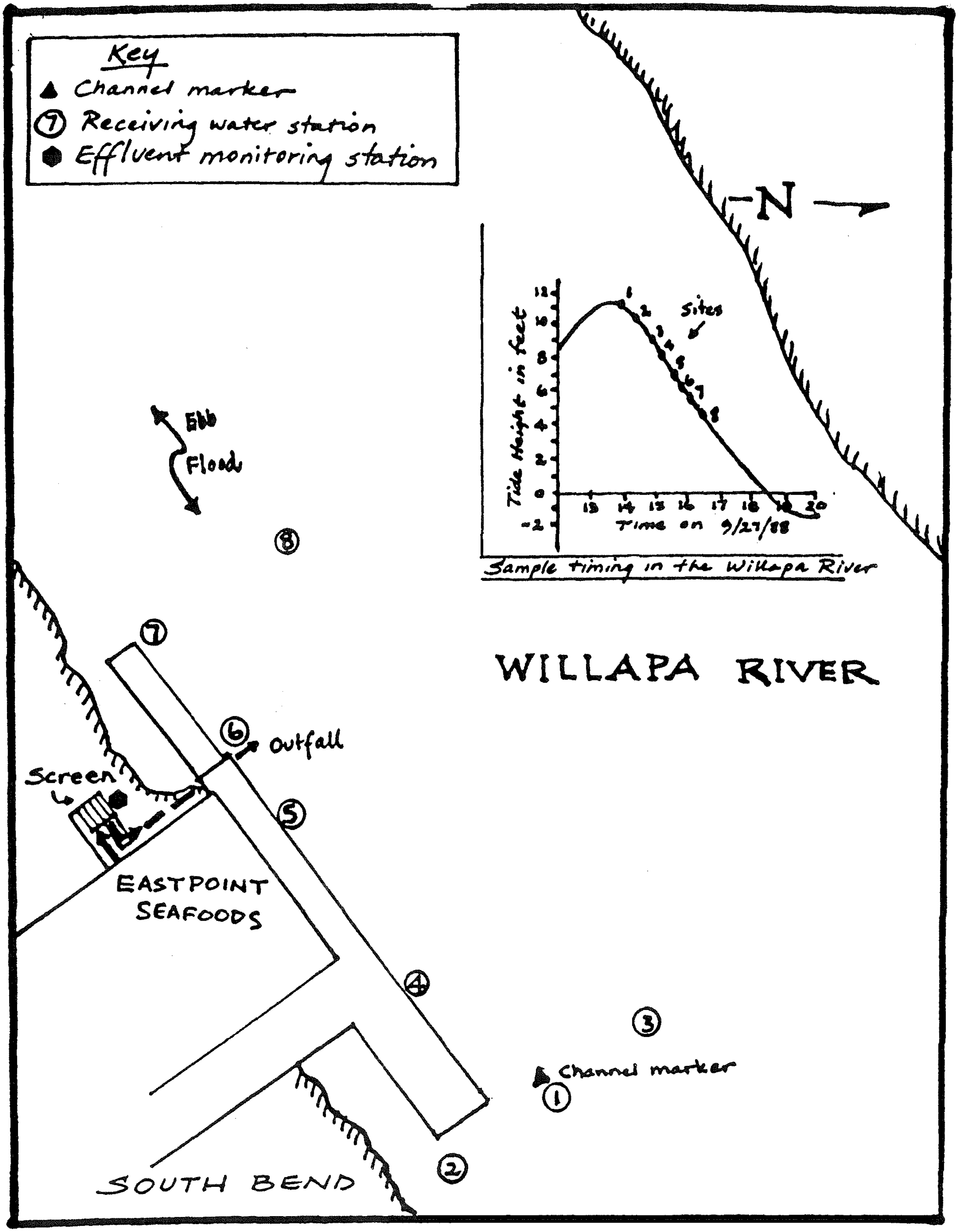

Figure 4. East Point Seafoods site and sampling locations used during the September 1988 survey.

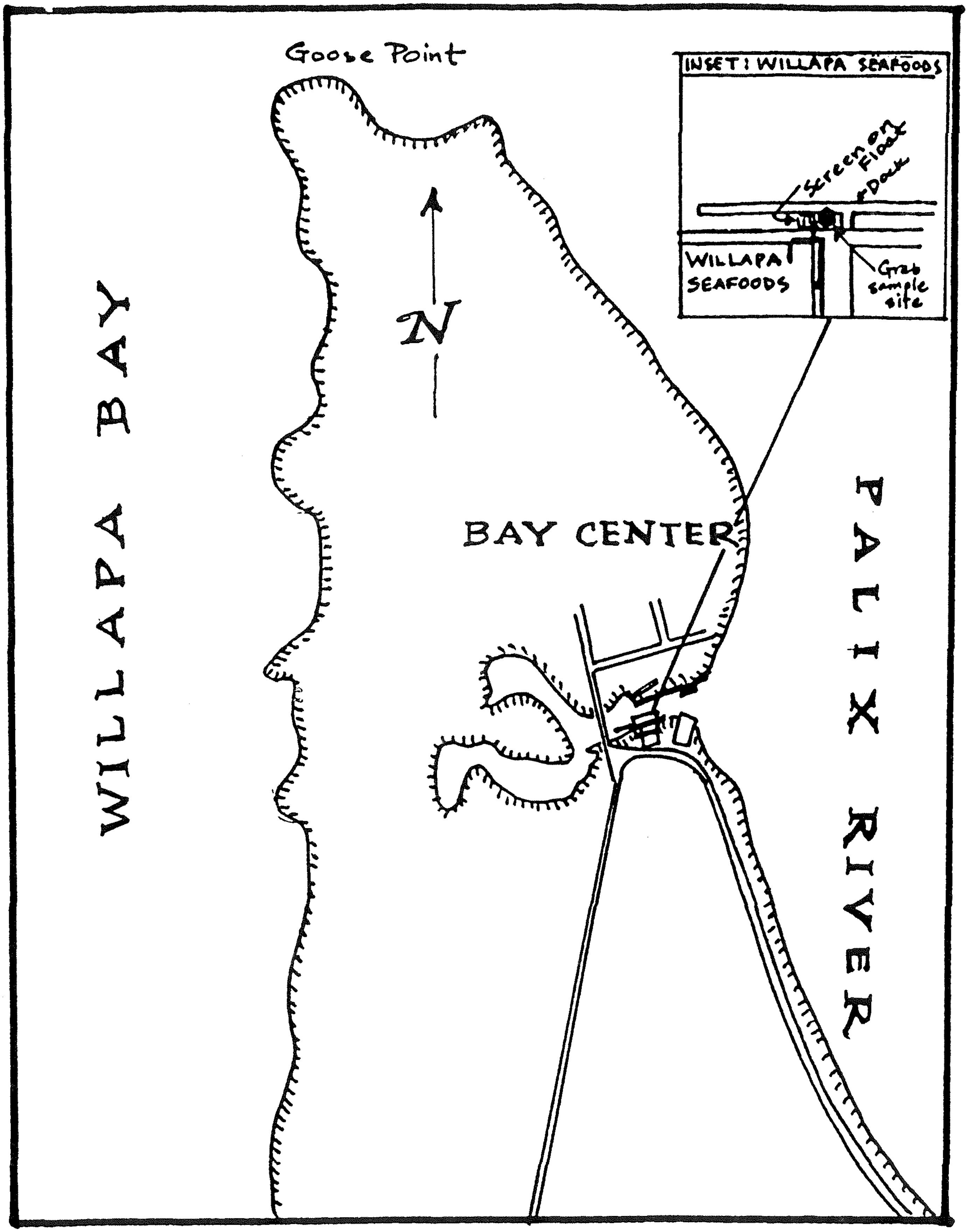

Figure 5. Willapa Seafoods site and sampling location used in the September 1988 survey.